WHAT IS CLAIMED IS:

1. Method for preparation and surface modification of plastic microfluidic chip, comprising:

prepare a plastic substrate is prepared;

form a pattern of trench with desired trench size and aspect ratio in said plastic substrate;

subject said substrate to physical surface modification;

treat surface of said substrate is treated with chemical reduction to produce hydroxyl groups (-OH); and

treat said substrate with a surface modification agent.

2. The method according to claim 1 wherein said plastic substrate is a PMMA substrate.

3. The method according to claim 1 wherein said plastic substrate is carved with a laser scriber to form said pattern.

4. The method according to claim 3 wherein said plastic substrate is carved with a direct write laser scriber to form said pattern.

5. The method according to claim 1 wherein said physical surface modification comprises thermal annealing treatment.

6. The method according to claim 1 wherein said reduction agent comprises lithium aluminum hydride (LAH).

7. The method according to claim 1 wherein said surface modification agent

comprises at least one chemical selected from the group consisted of chemicals with functional groups of perfluoroalkyl ($-C_nF_{2n+2}$), amino ($-NH_2$) or sulfhydryl (-SH).

8. The method according to claim 1 wherein said surface modification agent comprises fluorinated organosilanes.

9. The method according to claim 1 wherein said surface modification agent comprises aminated organosilanes.

10. The method according to claim 1 wherein said surface modification agent comprises thiolated organosilanes.

11. The method according to claim 1 wherein said surface modification agent comprises at least one chemical selected from the group consisted of 1H, 1H, 2H, 2H-Perfluorodecyltriethoxysilane, 3-(Aminopropyl)trimethoxysilane and 3-Mercaptotrimethoxysilane.

12. A plastic microfluidic chip prepared according to any one of claims 1-11.